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GRADE, TONNAGE AND LITHOLOGIC DATA FOR SEDIMENT-HOSTED SUBMARINE EXHALATIVE Zn-Pb AND SANDSTONE-HOSTED Pb-Zn DEPOSITS

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Introduction

The purpose of this paper is to release, document and update data on grades, tonnages and host and associated rock types for deposits used to build grade/tonnage models of sediment-hosted exhalative zinc-lead (Menzie and Mosier, 1983) and sandstone-hosted lead-zinc (Mosier, 1983) deposits. These data have been released because of expressed interest and because none of the data are confidential. In general, to be included in a grade/tonnage model several types of information must be available for a deposit. First, the geology of the deposit must be known to a sufficient degree that the deposit can be recognized as belonging to a particular deposit type. Geologic descriptions of these deposits were compared with descriptive models of Briskey (1983 a, b). Second, because grade/tonnage models are used to represent undiscovered deposits, it is desirable that deposit data include past production, reserves and resources at a uniform cutoff grade. For many deposits this standard is difficult to document. Nevertheless, it is usually possible to identify and eliminate deposits that are at a very early stage of exploration or for which a significant amount of past production is missing. Judgment is required to evaluate both factors and different geologists might reach different decisions. We welcome information on other deposits, corrections of our data and comments on the classification of individual deposits.

The data are presented in separate tables (1 and 2) for each deposit type, and include: deposit name, a location code, tonnage, grades, ages and lithologies of host and associated rock types and references for the data. Deposit name includes common synonyms in parenthesis; country codes are given in table 3. Tonnages are in millions of metric tons, grades are in percent unless otherwise indicated. Host and associated lithologies are presented in stratigraphic order, lowest to highest, where such information was available. Rock types that belong to the same unit are separated by commas; rock types that belong to different units are separated by semicolons. For sandstone hosted deposits, underlined lithologies are mineralized. For sediment-hosted exhalative, deposits underlined lithologies either are mineralized or are the footwall to massive sulfides. Ages are of the host and associated lithologies. Ages listed under the heading "Host Unit Lithology" are for basement rocks. Starred references identify sources of grade and tonnage data.

Table 1. Grade, tonnage, lithologic data and references for sediment-hosted Submarine Exhalative Zn-Pb deposits.

Name	Country	T x 10^6	Pb	Zn	Ag ppm	Cu	Other grades	Age	Host Unit Lithology	References
Balmat	USNY	21.	.5	9	--	--	--	Proterozoic	Dolomitic marbles, calcic marble, schist.	deLorraine and Dill (1982)*
Baroi	INDA	9.	3.53	1.51	34	--	--	Proterozoic	Graywacke, phyllite, dolomite, arkosic dolomite; phyllite.	Mining Mag. (1983), Deb and Bhattacharya (1980) Griffiths (1983)*
Big Syncline	SAFR	101.	1.01	2.45	11	.04	--	Archean(?)	Augen gneiss, pink gneiss, aluminous schist, white quartzite, schist, magnetite quartzite, nodular schist, calc-silicate, schist and quartzite amphibolite.	Black Mtn. Min. Dev. Co. Ltd., Mining Mag. (1979)*
Black Mountain	SAFR	86.	2.67	.56	23	.72	--	Archean(?)	Augen gneiss, pink gneiss, amphibolite, aluminuous schist, quartzite, schist, garnetiferous quartzite, quartz magnetite, amphibolite magnetite, granulite.	Black Mtn. Min. Dev. Co. Ltd., Mining Mag. (1979)*
Broken Hill	SAFR	72.	4.28	2.32	58	.38	--	Archean(?)	Gray gneiss, base schist, mineralized schist, amphibole magnetite garnetiferous quartzite, schist; mineralized schist, amphibole magnetite, quartz magnetite, ferruginous quartzite, schist, quartzite schist, pink gneiss.	Black Mtn. Min. Dev. Co. Ltd., Hammerbeck (1976)*
Broken Hill	AUNS	180.	11.3	9.8	175	--	--	L.-M. Proterozoic	Granite gneiss, amphibolite, gneiss, banded iron formation.	Gustafson and Williams (1981)*, Johnson and Klingner (1975)

Cirque	CNBC	30.	2.2	7.8	48	--	--	Devonian	Laminated silty shale with siltstone, sandstone, conglomerate and limestone; banded siliceous argillite, chert; carbonaceous black shale; aluminous shale.	MacIntyre (1982), Brown and others (1983)*
Cotton Belt	CNBC	.73	6.	5.	69	--	--	Proterozoic	Calc-silicate gneiss, impure phlogopite marble, pure, gray marble; stratiform carbonatite layer, kyanite-sillimanite schist with chert.	Canadian Department (1980)*
Dugald River	AUQL	1.3	1.6	11.6	37	--	--	M. Proterozoic	Calc-silicates; silicified quartzite and breccia-conglomerate, black shale; black argillaceous limestone; graphitic slates, schists, and lenses of dolomite and limestone; quartzite breccia-conglomerate and quartzite; scapolite granulites, quartzite and quartzite breccia; and quartzite.	Whitcher (1975)*
Duncan Lake	CNBC	9.	2.7	2.9	--	--	--	L. Cambrian	Thin bedded calcareous schist and quartzite, micaceous schist and quartzite; pure limestone with dolomite and chert lenses; dark argillite or micaceous schist.	Hoy (1982)*
Dy	CNYT	15.	5.6	7.1	84	--	--	Ordovician(?)	Graphitic phyllite	Canada Department (1980)*
Elura	AUNS	27.	5.6	8.3	139	--	--	L. Devonian	Thin bedded claystones, siltstones, fine to coarse grained sandstone and quartzite.	Engineering and Mining Jour. (1980)*

Faro	CNYT	58.	3.41	5.72	41	.16	--	Cambrian	Biotite-muscovite schist and muscovite phyllite; phyllite and schist; phyllite and schist; biotite-muscovite schist, and muscovite phyllite and breccia; tuffaceous schist or phyllite.	Irvine and Gondi (1972)*, Tempelman-Kluit (1970)
Fx (Kingfisher)	CNBC	1.6	.58	2.6	--	--	--	Proterozoic	Marble, quartzite, and calc-silicate gneiss.	Canada Department (1980)*
Grum	CNYT	35	4.23	6.69	64	--	--	Ordovician	Sericite-quartz phyllites and graphitic schists.	Marchand and other (1978)*
HB	CNBC	6.5	.77	4.1	4.8	--	--	L. Cambrian	Phyllite with calcareous lens; phyllite; banded limestone with lenses of dolomite; siliceous argillite; calcareous phyllite.	Hoy (1982)*, Fyles and Hewlett (1959)
Hilton	AUQL	37	7.7	9.5	179	--	--	M. Proterozoic	Siltstone; shale; pyritic shale; silty shale; pyritic shale; shale.	Mathias and Clark (1975), Australian Bureau of Mineral Resources (1977)*
Homestake	CNBC	1.5	2.5	4.	240	--	--	Proterozoic	Talcose, sericite schist and phyllite.	Canada Department (1980)*
Howards Pass	CNYT	270.	1.46	3.64	p[1/]	p	--	L. Silurian	Dolomitic and graphitic siltstone and black shale.	Annis and others (1976)*, Gustafson and Williams (1981)
Jersey Emerald	CNBC	7.7	1.65	3.49	3.1	--	w = .23	L. Cambrian	Crystalline, argillaceous limestone, argillite with calcareous beds; micaceous argillite, skarny calcareous argillite; crystalline limestone; black, calcareous argillite.	Hoy (1982)*, Fyles and Hewlett (1959)

King Fissure (River Jordan)	CNBC	2.6	5.1	5.6	38	--	--	Proterozoic	Micaceous quartzite with thin marble layers; quartzite and mica schist; mica schist, micaceous quartzite, minor calc-silicate gneiss and garnet mica schist; quartzite; mica schist, micaceous quartzite, calc-silicate gneiss; calc-silicate quartzite; mica schist and calc-silicate gneiss; calc-silicate gneiss, marble and barite lenses; mica schist, sillimanite schist and calc-silicate schist; calcite marble; mica schist and calc-silicate gneiss; marble; mica schist and calc-silicate gneiss; micaceous marble.	Canada Department (1980)*
Lady Loretta	AUQL	8.9	6.7	18.1	100	--	--	M. Proterozoic	Dolomitic and siliceous siltstone and carboniferous shale; massive pyrite beds with carbonaceous shale and siltstone; massive carbonaceous shale; thin beds of carbonaceous shale and dolomitic and siliceous siltstone; dolomitic, carbonaceous shale and siltstone; fine sandstone and siltstone.	Australian Bureau of Mineral Resources (1976)*, Loudon and others (1975)
MacMillan	CNYT	.91	5.	10.	62	--	--	Proterozoic	Quartzite, argillite, limestone conglomerate; quartzite and grit; black, fetid limestone and phyllite.	Canada Department (1980)*, Green (1966)
Matt Berry	CNYT	.59	6.1	4.6	93	p	Sb = .38	Paleozoic	Argillite and quartz-chlorite schist.	Canada Department (1980)*, Western Miner (1981)*

McArthur	AUNT	240	4.1	9.2	41	--	--	M. Proterozoic	Dolomite; tuff; dolomitic shales; pyritic shales; bituminous shales; pyritic shales; dolomitic shales and breccia.	Engineering and Mining Jour. (1980)*, Murray (1975)
Meggen	GRMY	60.	1.3	10.	3	.2	--	U. Devonian	Slates, graywacke, sandstone, keratophyre; marl, black shale, chert, silt and sandstone; shale and limestone.	Gustafson and Williams (1981)*, Large (1979)
Mel	CNYT	4.8	2.05	5.6	2.5	--	--	Cambrian	Calcareous shale, siltstone and minor limestone, dolomite and partially dolomitized limestone; light gray fine-grained limestone; laminated calcareous phyllite and shale; silty limestone.	Canada Department (1980)*, Miller (1979)
Mineral King	CNBC	2.4	2.18	4.73	23	.04	--	M. Proterozoic	Dark gray argillite; quartzite dolomite and argillite.	Canada Department (1980)*, Hoy (1982)
Mount Isa	AUQL	89	7.1	6.1	160	.06	Co=70 g/t	M. Proterozoic	Siltstone; shale and tuffs, pyritic shale and tuffs; silty shale; mineralized pyritic shale, tuffs.	Gustafson and Williams (1981)*, Mathias and Clark (1975)
Navan	IRLD	90	2.3	10	--	--	--	L. Carboniferous	Laminated argillites, argillaceous limestone, siltstone and sandstone; muddy limestone; calcarenite and oolites; shales, argillaceous calcarenite and oolites; reef limestones; limestone conglomerate.	Williams and McArdle (1978)*
Rajpura-Dariba	INDA	30.	1.70	6.14	54	.11	--	Proterozoic	Dolomite and amphiboite; calcareous biotite siliceous dolomite; ferruginous breccia; garnetiferous quartzite; quartzite, graphitic mica schist; calcareous biotite schist.	Griffiths (1983)*, Deb and Bhattacharya (1980)

Rammelsberg	GRMY	30.	9.	19.	85	1.	--	U. Devonian	Sandstone, black shale, limestone and tuff.	Carne (1979)*, Gustafson and Williams (1981)
Rampura-Agucha?	INDA	61.	1.57	13.48	54	--	--	Proterozoic	Mylonite; granite gneiss; garnet-biotite-sillimanite gneiss with interlayers of granite/gneiss/amphibole, calc-silicate and pegmatite; graphite-mica-sillimanite gneiss/schist; garnet-biotite-sillimanite gneiss and schist with interlayered amphibolites, calc-silicates and pegmatites.	Griffith (1982)* Mining Magazine (1983)
Red Dog	USAK	77	5	17.1	82	--	--	Mississippian	Gray and black, fissile shale with interbedded black limestone; black graphitic shale and chert; barite; sand and silt; chert and shale.	Am. Met. Market (1982)*, Plahuta and Robinson (1978)
Reeves MacDonald	CNBC	5.8	.98	3.42	3.4	--	Cd =.022	L. Cambrian	Phyllite and limestone; banded limestone; black calcareous phyllite; phyllite; micaceous quartzite and minor limestone.	Hoy (1982)*, Fyles and Hewlett (1959)
Rosh Pinah	NMBA	11.	2.	8.	p	.05-.8	Sb = p	U. Proterozoic(?)	Brecciated arkosic quartzite with layers of carbonaceous chert; argillite; carbonate rocks; microquartzite; quartzite; arkose; argillite.	Page and Watson (1976)*, Mining Joural (1969)
Silvermines	IRLD	18.	2.8	7.4	21	--	--	L. Carboniferous	Interbedded sandstone, sandy shale, calcareous shale and shaley limestone; dolomite and dolomitized limestone; bioclastic limestone with thin shale bands; dolomite breccia and reef limestone; cherty limestone; nodular limestone.	Gustafson and Williams (1981)*

Squirrel Hills	AUQL	1.8	.38	4.4	3.2	--	--	L. Proterozoic	Migmatites, quartzo-feldspathic gneiss, pelitic schists, quartzites, amphibolites.	Nisbet and Joyce (1980)*
Sullivan	CNBC	160.	6.10	5.9	68.	--	--	Proterozoic	Thin-bedded quartz sandstone, conglomerate; quartzite; laminated mudstone; quartz sandstone and mudstone; siltstone; conglomerate; siltstone; quartz sandstone and mudstone, thin bedded quartz sandstone and mudstone; quartzite.	Hamilton and others (1982)*
Swim Lake	CNYT	4.3	3.8	4.7	47	p	Au = p	Ordovician	Biotite muscovite schist to muscovite phyllite; white phyllite and schist and tuffaceous schist; biotite-muscovite schist to muscovite phyllite, graphite schist and phyllite.	Canada Department (1980)*, Tempelman-Kluit (1970)
Tom	CNYT	17	4.55	6.4	45	--	--	L. Devonian-Mississippian	Siltstones and shales with chert pebble conglomerate lenses; chert pebble conglomerate, sandstones and shales; pyritic shale and siltstone; black shale and mudstone, calcarenite, and black, fetid limestone.	Canada Department (1980)*, Carne (1979)
Tynagh	IRLD	12	4.9	4.5	58	.4	--	L. Carboniferous	Shale; limestone and shale and minor sandstone; bioclastic limestone; muddy limestone; reef limestone including slump breccia; calcilutite, slump breccia, biomicrite; siliceous limestone.	Gustafson and Williams (1981)*, Williams and McArdle (1978)

Vangorda	CNYT	8.5	3.18	4.96	60	.27	--	Ordovician	Biotite muscovite schist to muscovite phyllite; white phyllite and schist; disseminated sulfides in quartzite gangue; biotite muscovite schist, white phyllite, schist, tuffaceous schist and phyllite.	Tempelman-Kluit (1970), Canada Department (1980)*
Woodcutters L5	AUNT	.72	7.5	12.9	154	--	--	L. Proterozoic	Arkose graywacke, siltstone conglomerate, arkosic conglomerate, quartz sandstone; agal dolomite, silicified dolomitic breccia, tremolite schist; quartz graywacke, graywacke arkose, pebble conglomerate, siltstone, dolomitic marl; silicified metadolostone; quartz siltstone, carbonaceous siltstone, pyritic marl, argillaceous dolomite, dolomitic shale.	Taube (1980)*, Roberts (1975)
Wigman	CNBC	9.2	2.14	3.54	--	--	--	L. Cambrian	Thin-bedded calcareous schist and quartzite, micaceous schist and quartzite; pure limestone with dolomite and chert lenses; dark argillite or micaceous schist.	Canada Department (1980)*, Hoy (1982)
Zawar	INDA	39.	1.63	4.74	45	--	--	Proterozoic	Basal conglomerate; interbedded quartzite and arkosic quartzite, phyllite; arkosic dolomite; quartzite; phyllite.	Mookherjee (1964), Griffiths (1982)*
Zawarmala	INDA	18.	2.10	3.72	45	--	--	Proterozoic	Basal conglomerate; interbedded quartzite and arkosic quartzite, phyllite; arkosic dolomite; quartzite; phyllite.	Mookherjee (1964), Griffiths (1983)*

Footnotes

1/ p=present, grade not reported

Table 2.-Grade, tonnage, lithologic data and references for Sandstone-hosted Pb-Zn deposits.

		T x 10^6	Pb	Zn	Ag ppm	Au ppm	Others	Age of Host Unit	Host and Associated Lithologies	References
Belokany-Laurakizil	USSR	15.0	0.5	1.0	--	--	0.1% Cu	M. Jurassic	Sandstone, shale.	Laznicka (1973)*
Bou Mia	MRCO	1.4	2.8	--	--	--	--	Triassic	Paleozoic schist, granite; arkosic sandstone; red argillite; trachyte flows.	Bjorlykke and Sangster (1981)*
Boylen	CNQU	1.1	1.03	6.7	55.0	1.0	0.7% Cu	L. Proterozoic	Quartizite, graphitic phyllites, schist.	Canada Department (1980),* Dugas (1970), Laurin (1969)
George Lake	CNSK	4.6	0.4	2.7	--	--	--	L. Proterozoic	Archean granite; boulder conglomerate; meta-arkose; quartzite, meta-argillite; calcareous quartzite; meta-arkose.	Bjorlykke and Sangster (1981)*
Galaa (Rena)	NRWY	1.0	4.0	0.08	--	--	--	U. Proterozoic	Quartz sandstone	Bjorlykke and and others (1980)*
Guttusjon	SWDN	2.7	3.5	--	--	--	--	L. Cambrian	Quartz sandstone.	Stephens and others (1979)*
Laisvall	SWDN	80.0	4.3	0.6	9.0	<0.1	<0.01% Cu	U. Proterozoic-L. Cambrian	Basal conglomerate; feldspathic sandstone; shale; quartz sandstone; siltstone; alum shale.	Bjorlykke and Sangster (1981), Rickard and others (1979), Gustafson and
Largentiere	FRNC	10.0	3.8	0.8	80.0	--	--	L. Triassic	Permian sandstone and conglomerate; arkosic sandstone-conglomerate; fine sandstone with argillite; silty argillite; shale; dolomite; shale.	Bjorlykke and Sangster (1981), Gustafson and Williams (1981)*

Table 2.(Continued) -Grade tonnage, lithologic data and references for Sandstone-hosted Pb-Zn deposits.

		T x 10^6	Pb	Zn	Ag ppm	Au ppm	Others	Age of Host Unit	Host and Associated Lithologies	References
Lovstrand	SWDN	12.0	2.4	--	--	--	--	U. Proterozoic-L. Cambrian	Quartzite.	Grip (1978), Stephens and others (1979)*
Maiva	SWDN	1.0	5.1	0.1	10.0	--	--	U. Proterozoic-L. Cambrian	Arkosic sandstone (sequence probably same as Laisvall).	Grip (1978), Stephens and others (1979)*
Maubach	GRMY	12.0	2.0	0.8	3.0	--	0.2% Co 0.1% Ni	L. Triassic	Devonian metasediment; breccia; conglomerate with sandstone; coarse conglomerate; red conglomerate; sandy shale and argillaceous sandstone.	Bjorlykke and Sangster (1981)*
Mechernich	GRMY	230.0	1.6	0.3	3.0	--	--	L. Triassic	Devonian graywacke; clayey sandstone; sandstone and conglomerate; sandstone with shale interlayers.	Bjorlykke and Sangster (1981)*
Oberpfalz	GRMY	10.0	2.0	--	26.0	--	0.005% Cu	Triassic	Precambrian gneisses and granites; feldspathic sandstone with conglomerate; feldspathic sandstone with carneole; feldspathic sandstone, dolomite, evaporites; dolomitic limestone, marlstone, sandstone; sandstone, evaporites.	Bjorlykke and Sangster (1981)*
Osen	NRWY	0.1	3.0	0.2	--	--	--	M. Cambrian	Middle Proterozoic granite and gneiss; arkose; quartzite; dark sandstone; gray siltstone; conglomerate; black shale.	Bjorlykke and Sangster (1981)*

Table 2. (Continued) -Grade, tonnage, lithologic data and references for Sandstone-hosted Pb-Zn deposits.

		T x 10^6	Pb	Zn	Ag ppm	Au ppm	Others	Age of Host Unit	Host and Associated Lithologies	References
Sagliden	GRMY	13.0	1.6	--	--	--	--	L. Cambrian	Quartz sandstone	Stephens and others (1979)*
Smithfield	CNNS	0.5	3.0	3.0	--	--	--	Mississippian	Conglomerate, sandstone, limestone.	Laznicka (1973)*
Snertingdal (Ringsjoen)	NRWY	1.0	1.5	0.02	--	--	0.001% Cu	U. Proterozoic	Orthoquartzite.	Bjorlykke and others (1980), Bjorlykke and Sangster (1981)*
Tregioivo	ITLY	1.0	2.5	2.5	--	--	0.12% Cu	Permian	Feldspathic sandstone, bituminous marl, chert, dolomite.	Laznicka (1973)*
Vassbo	SWDN	5.0	5.5	0.6	18.0	0.1	0.01% Cu	L. Cambrian	L. Proterozoic quartz porphyry, sandstone, diabase dikes; conglomerate; shale; coarse sandstone; quartz sandstone; coarse quartz sandstone; conglomerate black shale.	Stephens and others (1979)* Bjorlykke and Sangster 1981)
Yava (Silvermine)	CNNS	71.2	2.1	0.07-0.8	1.7	--	--	Carboniferous	Cambrian siltstone, gypsiferous black shale, limestone, felsite, fanglomerate shales; sandstone with conglomerate, mudstone, and grit.	Bjorlykke and Sangster (1981)*
Zeida	MRCO	23.0	3.1	--	--	--	--	Triassic	Paleozoic schist; arkosic sandstone; red argillite; trachyte flows.	Bjorlykke and Sangster (1981)*

Table 3. -Country Province/State Codes

AUNS	Australia, New South Wales
AUQL	Australia, Queensland
CNBC	Canada, British Columbia
CNNS	Canada, Nova Scotia
CNQU	Canada, Quebec
CNSK	Canada, Saskatchewan
CNYT	Canada, Yukon
FRNC	France
GRMY	Germany
INDA	India
IRLD	Ireland
ITLY	Italy
MRCO	Morocco
NMBA	Namibia
NRWY	Norway
SAFR	South Africa
SWDN	Sweden
USAK	U.S., Alaska
USNY	U.S., New York
USSR	Russia

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